# FTIR SPECTROSCOPIC DIFFERENTIATION OF PORK AND BEEF MIXTURES BASED ON PROTEIN FRACTIONS

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**Abstract – Fourier Transform Infrared (FTIR) spectroscopy is a versatile technique for characterization of secondary structure of proteins. The aim of this study was to differentiate beef and pork mixtures based on sarcoplasmic and myofibrillar protein fractions by using this technique. FTIR spectra of sarcoplasmic and myofibrillar protein fractions from mixtures prepared by adding 0, 5, 10 and 100% pork into beef exhibited different patterns in the mid-infrared region (4000-850 $cm^{-1}$). According to dendograms from hierarchical cluster analysis, only myofibrillar protein fractions could be used to distinguish beef and pork in the regions at the wave numbers of 1200-900 $cm^{-1}$ and 3400-3300 $cm^{-1}$ suggesting that myofibrillar protein-specific spectra determined in this study have potential to be used for species identification.**

**Key Words – Beef and pork mixtures, FTIR spectroscopy, Myofibrillar and sarcoplasmic proteins**

## I. INTRODUCTION

Recent studies on product characterization and food fraud determination using chromatographic and spectroscopic methods have been mostly focused on identifying differences in the product composition and classifying the products based on these differences. In recent years, Fourier Transform Infrared (FTIR) spectroscopy together with chemometric methods has been widely used as a valuable tool for these purposes. It has been shown that sarcoplasmic and myofibrillar proteins showed differences characteristic for certain animal species [1]. FTIR spectroscopy is a convenient method to examine protein conformation and could be used in studies related to protein secondary structure and protein dynamics [2]. There is lack of information regarding FTIR spectra of protein fractions of meat products. The aim of this study was to differentiate pork and beef depending on sarcoplasmic and myofibrillar protein fractions using FTIR spectroscopy with hierarchical cluster analysis as a chemometric method.

## II. MATERIALS AND METHODS

Beef and pork *Longissimus dorsi* muscles were used throughout this study. Pork was added into beef at 0, 5, 10 and 100% (wt/wt). Extracted sarcoplasmic and myofibrillar protein fractions [3] from these mixtures were lyophilized and FTIR spectra were recorded for each fraction in the mid-infrared region (4000-850 $cm^{-1}$) by using attenuated total reflectance (ATR). Spectral acquisition and data analysis were done by OPUS software (Version 5.5, Bruker Inc., USA). Hierarchical cluster analysis (HCA) was used to group mixtures based on their spectral similarities in the characteristic regions.

## III. RESULTS AND DISCUSSION

Zoomed view of the spectra of pork/beef mixtures were evaluated with cluster analysis aiming species identification through proteins which have the species-specific differences [4]. In the FTIR spectra, peaks originated from amide B (~3100), amide I (~1630 $cm^{-1}$), amide II (~1552 $cm^{-1}$) and amide III (~1296 $cm^{-1}$) for the sarcoplasmic protein fraction, and from amide A (~3300), amide B, amide I and amide II for myofibrillar protein fraction were detected [5-7]. In the myofibrillar protein fraction, the signals from phosphate bonds were also observed at the wave numbers 1153, 1084, 1005 $cm^{-1}$ [6, 7]. Zoomed view of FTIR spectra obtained from myofibrillar protein fraction in the regions 1200-900 $cm^{-1}$ and 3600-3000 $cm^{-1}$ are shown in Figure 1. The sarcoplasmic protein fraction did not show a significant difference in HCA (data not shown). Myofibrillar protein fraction enables to classify beef and pork in the meat mixtures into two regions at the wave numbers of 1200-900 $cm^{-1}$ and 3400-3300 $cm^{-1}$ with pre-processing type vector normalization. As shown in Figure 2, vector normalization as a pre-processing type exhibited a clear distribution of the data into the clusters obtained with HCA.

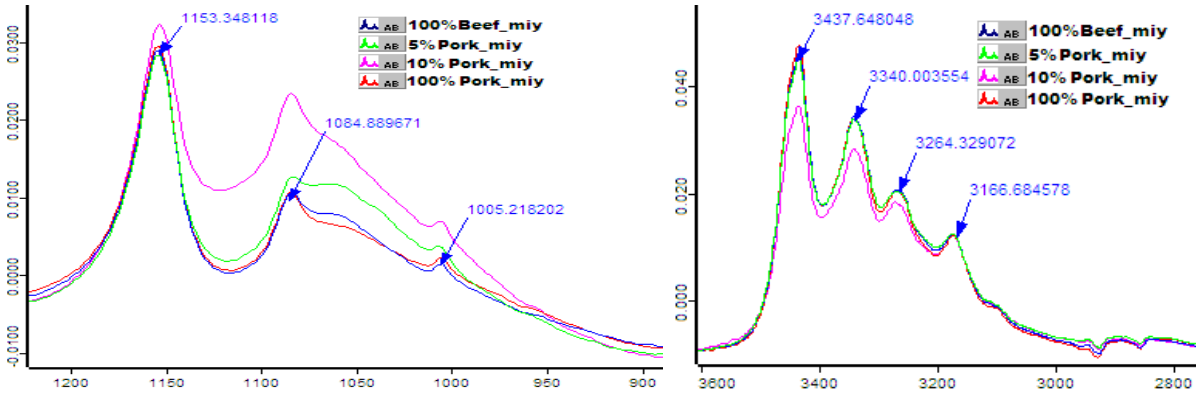


Figure 1. Zoomed view of FTIR spectra (x-axis: wave numbers, $cm^{-1}$; y-axis: absorbance) obtained from myofibrillar protein fractions of beef-pork mixtures in the 1200-900 $cm^{-1}$ and 3600-3000 $cm^{-1}$ regions.

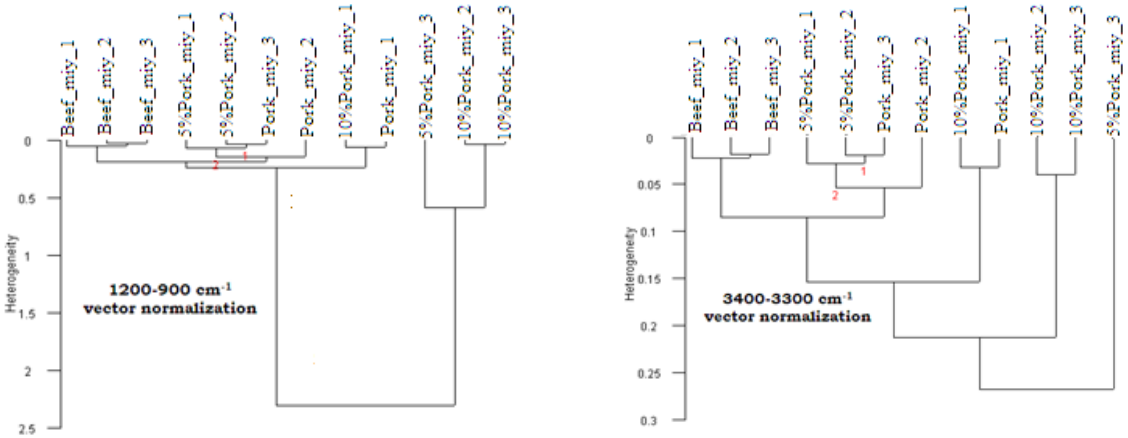


Figure 2. Dendrograms of the mean spectra of myofibrillar protein fractions of beef-pork mixtures

## IV. CONCLUSIONS

Although sarcoplasmic and myofibrillar protein fractions exhibited a distinctive FTIR spectral pattern from each other; only myofibrillar protein fraction is capable to discriminate pork from beef in raw meat mixtures using dendograms obtained from HCA. FTIR spectroscopy is a promising analytical methodology for detection of fraud incidents using myofibrillar protein fractions as an alternative to other methods commonly used for meat authentication purposes.

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